

APPLICANT'S REMARKS MADE IN AN AMENDMENT

Applicants have carefully reviewed and considered the Office Action mailed on July 24, 2008, and the references cited therewith.

Claims 1-8, 10-21, 23-31, and 33-65 are pending in the current application. No amendments are being made to the claims. A clean copy of the pending claims is being provided for the Examiner's convenience. Please charge any necessary fee or credit overpayment to Deposit Account No. 502931.

Claim Rejections Under 35 U.S.C. § 112

In the Office Action, the Examiner asserted,

"The term "thin" in claims 33, 34, 44, 45, 55, & 56 are a relative term which renders the claim indefinite. The term "thin" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention."

Applicants respectfully traverse the rejection because Applicants respectfully submit that the terminology used in the claims would be understood by a person with skill in the art and is therefore not indefinite. To begin, Applicants respectfully submit that the Office Action has improperly dissected the claim language (i.e., not taking the claim language as a whole) as would be understood by one of skill in the art. For example, the Office Action asserts that the term "thin" is indefinite, however, Applicants respectfully submit that the term "thin" is not meant to be judged independent of the whole term "thin film" recited in claims 33, 44 and 55, which is a well-known term in the art and would be understood by a person of skill in the art. The Applicants respectfully submit that the term "thin film" when taken in the context of the claim (i.e., a "thin film" of metal used to provide a source electrode and a drain electrode) is not indefinite and would be well understood by one of skill in the art because thicknesses of metal source and drain electrodes have been well established in the art. Similarly, the whole term "thin conducting film" recited in claims 34, 45 and 56 when taken in the context of the claim (i.e., a "thin conducting film" used to provide a gate electrode) is not indefinite and would be well understood by one of skill in the art because thicknesses of gate electrodes have been well established in the art. When used in the context of semiconductor arts,

one of skill in the art understands that “thin films” are thin material layers (e.g., metals, insulators, dielectrics, semiconductors, and the like) deposited generally onto a substrate whose thickness can range from a fraction of a nanometer up to several microns. Furthermore, Applicants respectfully submit that the specification (paragraph [0059]) provides an example that forms direct support for one such thickness of the “thin film” as used in claims 33, 44, and 55. Therefore, for at least the reasons discussed above, the Applicants respectfully submit that claims 33, 34, 44, 45, 55, and 56 are not indefinite and appear in condition for allowance. Reconsideration and withdrawal of the rejection and an early indication of allowance of the claims is respectfully requested.

Claim Rejections Under 35 U.S.C. § 102(e)

1) The Applicable Law for Rejections under 35 U.S.C. § 102

35 U.S.C. 102 Conditions for patentability; novelty and loss of right to patent.

A person shall be entitled to a patent unless –

...

(e) the invention was described in - (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for the purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language;

For a cited reference to be prior art within the meaning of 35 U.S.C. § 102(e), all of the claim limitations must be anticipated by the cited reference. See MPEP 2131: “A claim is anticipated only if **each and every element** as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir.1987). Additionally, “[a]nticipation requires the presence in a single prior reference disclosure of each and every element of the claimed invention, **arranged as in the claim.**” *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984) (citing *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)) (emphasis added). The elements must be arranged as required by the claim, but this is not an *ipsissimis verbis* test, i.e., identity of

terminology is not required. *In re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990). “The **identical invention** must be shown **in as complete detail as is contained in the ... claim.**”

Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir.1989) (emphasis added).

2) Analysis

In the August 21, 2008 Office Action, claims 1-4, 6-8, 10, 12, 14-18, 20-21, 23-27, 29-31, 34, 44, & 55 were rejected under 35 U.S.C. 102(b) as being anticipated by Gardner et al., (U.S. Patent 6,207,995), hereafter referred to as *Gardner et al.* The Applicants respectfully traverse the rejection because the cited reference, *Gardner et al.*, does not disclose each and every element of the claimed invention, arranged as in the claim.

Regarding claims 1, 15 and 24 the Examiner asserted,

“Regarding claims 1, 15, & 24, Gardner discloses that a method of manufacture of a device for regulating the flow of electrical current, the method comprising: providing for a semiconductor substrate 12 (Fig. 2);

providing for an electrically insulating layer 38 in contact with the semiconductor substrate 12 (Fig. 2), the insulating layer having a dielectric constant greater than 4.0, 7.6, or 15 (col. 5, lines 15-25, note: a dielectric constant of TiO₂ is approximately 50-60);

providing for a gate electrode 20 in contact with at least a portion of the insulating layer 38 (Fig. 2); and

providing a source electrode and a drain electrode 34 in contact with the semiconductor substrate 12 and proximal to the gate electrode 22 wherein a channel 28 is formed between the source electrode and the drain electrode 34, and further wherein at least one of the source electrode and the drain electrode forms a Schottky contact

(note: silicide) or Schottky-like region with the semiconductor substrate and channel (Fig. 2).”

Applicants respectfully disagree and respectfully submit that the Office Action has failed to make a *prima facie* case of anticipation under 35 U.S.C. §102(b) because *Gardner et al.* fail to provide for each and every element arranged as recited in claim 1 of the present invention.

To begin, the Applicants submit that one of skill in the art realizes that it is important to understand the difference between a Schottky-barrier metal source-drain MOSFET device and manufacturing method (such as the methods recited in claims 1, 15 and 24 of the present invention) and a conventional impurity-doped source-drain MOSFET device and its manufacturing method

(such as the device and method described in *Gardner et al.*). As is well known in the art, conventional impurity-doped source-drain MOSFET devices utilize impurity doping to form the source and drain regions of the MOSFET and further, the source and drain regions form p-n junctions with the channel region of the device. Conventional MOSFET devices utilize metal silicides to form source and drain contacts, also called source and drain electrodes, that are used to form low resistance contacts with the source and drain regions respectively for making electrical connection to the device. The metal silicide source and drain electrodes of a conventional MOSFET device do not form the source and drain regions and do not contact the channel of the device. The metal silicide source and drain electrodes of a conventional MOSFET will generally form ohmic contacts with the source and drain regions, although in some devices the metal silicide source and drain electrodes will form Schottky contacts with the source and drain regions. In either case, for a conventional MOSFET, the source and drain electrodes do not form a contact directly with the channel of the device, rather it is the source and drain regions that directly contact the channel and, as discussed above, form p-n junctions with the channel.

In contrast to the above described conventional impurity-doped MOSFET, a Schottky-barrier metal source-drain MOSFET has metal source and drain electrodes that provide the function of both the source and drain regions and the source and drain electrodes. That is, the metal source and drain of the Schottky-barrier MOSFET directly contact the channel of the device and also act as a low resistance contact for making electrical connection to the device. The metal source and drain electrodes of the Schottky-barrier MOSFET each form a Schottky junction with the channel (i.e., between the metal source electrode and the channel and another between the metal drain electrode and the channel). The Schottky-barrier MOSFET device of the present invention does not use impurity doping in the source and drain of the device.

Applicants respectfully submit that independent claims 1, 15 and 24 recite “providing a source electrode and a drain electrode in contact with the semiconductor substrate and proximal to the gate electrode wherein a channel is formed between the source electrode and the drain electrode, and further wherein at least one of the source electrode and the drain electrode forms a Schottky

contact or Schottky-like region with the semiconductor substrate and the channel.” *Gardner et al.* describe implanting impurity ions into the substrate 12 in order to form source and drain regions 24 and 26 respectively (Figure 6, column 7, lines 30 - 39). Applicants respectfully submit that the device of *Gardner et al.* uses impurity doped source and drain regions and one of skill in the art would understand that these impurity doped source and drain regions of *Gardner et al.* will form p - n junctions with the channel region 28. Applicants respectfully disagree with the Examiner’s assertion that silicide layer 34 (*Gardner et al.* Figure 2) is in contact with the semiconductor substrate 12 and forms a Schottky contact with the semiconductor substrate 12 and the channel 28. As stated in *Gardner et al.* (column 4, lines 26 - 31), “Enhanced ohmic contact between the source/drain regions 24 and 26, the gate electrode 22 and any subsequent metallization is provided by a silicide layer 34 formed on the source/drain regions 24 and 26 and the gate electrode 22.” Applicants respectfully submit that silicide layer 34 in *Gardner et al.* is not a source electrode and a drain electrode that forms a Schottky contact with both the substrate and the channel as recited in claims 1, 15 and 24 of the present application, rather silicide layer 34 is a metal layer used to provide enhanced ohmic contact (i.e., a low-resistance contact) to the source and drain regions 24 and 26. *Gardner et al.* do not describe or suggest that the source and drain regions 24 and 26 are metal and form Schottky contacts with the channel region. Further, *Gardner et al.* do not describe or suggest that silicide layer 34 forms a Schottky contact with the channel region. Applicants respectfully submit that, therefore, the device of *Gardner et al.* is a conventional impurity-doped MOSFET, not a Schottky barrier metal source-drain MOSFET as recited in the present invention.

For at least the reasons provided above, Applicants respectfully submit that *Gardner et al.* fail to provide each and every element arranged as recited in claims 1, 15 and 24 of the present invention and therefore claims 1, 15 and 24 distinguish over *Gardner et al.* and thus the Office Action has failed to provide a *prima facie* case supporting a rejection under 35 U.S.C. §102(b).

Upon the foregoing discussion of applicable law, relevant precedents, and the art cited by the Examiner, Applicants respectfully submit that claims 1, 15 and 24 of the present application appear to be in condition for allowance. Accordingly, reconsideration and withdrawal of the rejection and early indication of allowance of claims 1, 15 and 24 are respectfully requested.

Regarding claims 2 - 8 and 10 - 14, these claims depend from independent claim 1 or an intermediary claim that itself depends from claim 1, which as argued above, Applicants respectfully submit distinguishes over the referenced prior art. Therefore, Applicants respectfully submit that claims 2 - 8 and 10 - 14, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claim 1. Reconsideration and withdrawal of the rejection and an early notice of allowance of the claims are respectfully requested.

Regarding claims 16 - 21 and 23, these claims depend from independent claim 15 or an intermediary claim that itself depends from claim 15, which as argued above, Applicants respectfully submit distinguishes over the referenced prior art. Therefore, Applicants respectfully submit that claims 16 - 21 and 23, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claim 15. Reconsideration and withdrawal of the rejection and an early notice of allowance of the claims are respectfully requested.

Regarding claims 25 - 31, these claims depend from independent claim 24 or an intermediary claim that itself depends from claim 24, which as argued above, Applicants respectfully submit distinguishes over the referenced prior art. Therefore, Applicants respectfully submit that claims 25 - 31, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claim 24. Reconsideration and withdrawal of the rejection and an early notice of allowance of the claims are respectfully requested.

Further regarding claims 2-3, 16-17 and 25-26, the Examiner asserted,

“Regarding claims 2-3, 16-17, & 25-26, as applied to claims 1, 15, & 24, Gardner discloses that the source and drain electrode are formed from a member of the group consisting of: platinum silicide, palladium silicide and iridium silicide (Col. 8, lines 11- 19).”

Applicants respectfully disagree and respectfully submit that the Office Action has failed to make a *prima facie* case of anticipation under 35 U.S.C. §102(b) because *Gardner et al.* fail to provide for each and every element arranged as recited in claims 2-3, 16-17 and 25-26 of the

present invention.

Applicants respectfully submit that, as discussed above, while *Gardner et al.* mention platinum and palladium silicides, silicide layer 34 of *Gardner et al.* is not equivalent to the metal source and drain electrodes of the present invention, wherein the source and drain electrodes form Schottky-barrier contacts with the channel region. Therefore, *Gardner et al.* do not provide metal source and drain electrodes formed from a member of the group consisting of: platinum silicide, palladium silicide and iridium silicide, arranged as recited in the claims. Therefore, Applicants respectfully submit that claims 2-3, 16-17 and 25-26, appear to be in condition for allowance. Reconsideration and withdrawal of the rejection and an early notice of allowance of the claims are respectfully requested.

Further regarding claims 6, 20 and 29, the Examiner asserted,

“Regarding claims 6, 20, & 29, as applied to claims 1, 15, & 24, Gardner discloses that the Schottky contact or Schottky-like region is formed at least in areas adjacent to the channel (Fig. 2).”

Applicants respectfully disagree and respectfully submit that the Office Action has failed to make a *prima facie* case of anticipation under 35 U.S.C. §102(b) because *Gardner et al.* fail to provide for each and every element arranged as recited in claims 6, 20 and 29 of the present invention.

Applicants respectfully submit that, as discussed above, silicide layer 34 of *Gardner et al.* forms an ohmic contact (column 4, lines 27-31) with the source and drain regions 24 and 26 and further, that *Gardner et al.* do not discuss nor describe a Schottky contact anywhere within their entire patent. Applicants respectfully submit that silicide layer 34 of *Gardner et al.* forms a contact only with the source and drain regions 24 and 26 and does not contact the substrate 12 or the channel 28 in any way. Applicants respectfully submit that when the source and drain regions 24 and 26 are formed by implanting impurity doping into the substrate, those regions are chemically modified from the substrate and therefore cease to be considered the substrate. Accordingly,

Applicants respectfully submit that it is well known to those having skill in the semiconductor arts that layers or regions that are formed on or in the impurity doped source and drain regions only contact these source and drain regions and do not contact the semiconductor substrate or channel. Applicants respectfully submit that the source and drain regions 24 and 26 are adjacent to the channel 28 and form p-n junctions with the channel 28 and therefore the silicide layer 34 does not form a Schottky contact or Schottky-like region at least in areas adjacent to the channel as recited in claims 6, 20 and 29 of the present invention. Therefore, Applicants respectfully submit that claims 6, 20 and 29, appear to be in condition for allowance. Reconsideration and withdrawal of the rejection and an early notice of allowance of the claims are respectfully requested.

Further regarding claims 7, 21 and 30, the Examiner asserted,

“Regarding claims 7, 21, & 30, as applied to claims 1, 15, & 24, Gardner discloses that an entire interface between at least one of the source electrode and drain electrode and the semiconductor substrate forms a Schottky contact 34 or Schottky-like region with the semiconductor substrate (Fig. 2).”

Applicants respectfully disagree and respectfully submit that the Office Action has failed to make a *prima facie* case of anticipation under 35 U.S.C. §102(b) because *Gardner et al.* fail to provide for each and every element arranged as recited in claims 7, 21 and 30 of the present invention.

Applicants respectfully submit that, as discussed above, silicide layer 34 of *Gardner et al.* forms an ohmic contact (column 4, lines 27-31) with the source and drain regions 24 and 26 and further, that *Gardner et al.* do not discuss nor describe a Schottky contact anywhere within their entire patent. Applicants respectfully submit that, as discussed above, the silicide layer 34 does not contact the semiconductor substrate and further that an entire interface between the the silicide layer 34 does not form a Schottky contact or Schottky-like region with the semiconductor substrate as recited in claims 7, 21 and 30 of the present invention. Therefore, Applicants respectfully submit that claims 7, 21 and 30, appear to be in condition for allowance. Reconsideration and withdrawal of the rejection and an early notice of allowance of the claims are respectfully requested.

Further regarding claim 12, the Examiner asserted,

“Regarding claim 12, as applied to claims 2 or 3, Gardner discloses that the Schottky contact or Schottky-like region is formed at least in areas adjacent to the channel (Fig. 2).”

Applicants respectfully disagree and respectfully submit that the Office Action has failed to make a *prima facie* case of anticipation under 35 U.S.C. §102(b) because *Gardner et al.* fail to provide for each and every element arranged as recited in claim 12 of the present invention.

Applicants respectfully submit that, as discussed above, silicide layer 34 of *Gardner et al.* forms an ohmic contact (column 4, lines 27-31) with the source and drain regions 24 and 26 and further, that *Gardner et al.* do not discuss nor describe a Schottky contact anywhere within the entire patent. Applicants respectfully submit that, as discussed above, the silicide layer 34 does not contact the semiconductor substrate and further that the silicide layer 34 does not form a Schottky contact or Schottky-like region at least in areas adjacent to the channel as recited in claim 12 of the present invention. Therefore, Applicants respectfully submit that claim 12 appears to be in condition for allowance. Reconsideration and withdrawal of the rejection and an early notice of allowance of the claims are respectfully requested.

Further regarding claim 14, the Examiner asserted,

“Regarding claim 14, as applied to claims 2 or 3, Gardner discloses that providing a source electrode and a drain electrode 34 in contact with the semiconductor substrate 12 is performed at a processing temperature of less than about 800 °C (col. 8, lines 12- 18).”

Applicants respectfully disagree and respectfully submit that the Office Action has failed to make a *prima facie* case of anticipation under 35 U.S.C. §102(b) because *Gardner et al.* fail to provide for each and every element arranged as recited in claim 14 of the present invention.

Applicants respectfully submit that, as discussed above, silicide layer 34 of *Gardner et al.* forms an ohmic contact (column 4, lines 27-31) with the source and drain regions 24 and 26, not

with the semiconductor substrate 12. Applicants respectfully submit that, the silicide layer 34 does not contact the semiconductor substrate as recited in claim 14 of the present invention, but rather the silicide layer 34 forms ohmic contacts with the source or drain regions on the substrate. Therefore, Applicants respectfully submit that claim 14, appears to be in condition for allowance.

Reconsideration and withdrawal of the rejection and an early notice of allowance of the claims are respectfully requested.

Regarding claims 33, 44 and 55, the Examiner asserted,

“ Regarding claims 33, 44, & 55, Gardner discloses a method for manufacture of a device for regulating the flow of electrical current, the method comprising: providing for a semiconductor substrate 12 (Fig. 2);
providing for an electrically insulating layer 38 in contact with the semiconductor substrate 12 (Fig. 2), the insulating layer having a dielectric constant greater than 4.0, 7.6, or 15 (col. 5, lines 15-25, note: a dielectric constant of TiO₂ is approximately 50-60);
providing for a gate electrode 20 in contact with at least a portion of the insulating layer 38 (Fig. 2);
exposing the semiconductor substrate on one or more areas proximal to the gate electrode;
providing for a thin film of metal on at least a portion of the exposed semiconductor substrate; and
reacting the metal with the exposed semiconductor substrate such that a source electrode and a drain electrode 34 formed and wherein a channel 28 is formed between the source electrode and the drain electrode 34, and further wherein at least one of the source electrode and the drain electrode forms a Schottky contact (note: silicide) or Schottky-like region with the semiconductor substrate and channel (Fig. 2, col 8, lines 440).”

Applicants respectfully disagree and respectfully submit that the Office Action has failed to make a *prima facie* case of anticipation under 35 U.S.C. §102(b) because *Gardner et al.* fail to provide for each and every element arranged as recited in claims 33, 44 and 55 of the present invention.

Applicants respectfully submit that, as discussed above, silicide layer 34 of *Gardner et al.* is not equivalent to the metal source and drain electrodes recited in claims 33, 44 and 55 of the present invention, wherein the source and drain electrodes form Schottky-barrier contacts with the channel region. Therefore, Applicants respectfully submit that *Gardner et al.* do not provide metal source and drain electrodes that form Schottky contacts with the semiconductor substrate and the channel

as recited in claims 33, 44 and 55 of the present invention, but rather the silicide layer 34 forms ohmic contacts with the source or drain regions on the substrate. Therefore, Applicants respectfully submit that claims 33, 44 and 55, appear to be in condition for allowance. Reconsideration and withdrawal of the rejection and an early notice of allowance of the claims are respectfully requested.

Claim Rejections - 35 USC § 103

1) The Applicable Law for Rejections under 35 U.S.C. § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The Examiner has the burden under 35 U.S.C. §103 to establish a *prima facie* case of obviousness. *In re Fine*, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *M.P.E.P.* §2142 (citing *In re Vaeck*, 947 F.2d, 488, 20 USPQ2d 1438 (Fed. Cir. 1991)).

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *M.P.E.P.* §2142 (citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)). The references must expressly or impliedly suggest the claimed invention or the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references. *M.P.E.P.* §2142 (citing *Ex parte Clapp*, 227 USPQ 972, 973

(Bd. Pat. App. & Inter. 1985)). In considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom. *M.P.E.P.* §2144.01 (citing *In re Preda*, 401 F. 2d 825, 826, 159 USPQ 342, 344 (CCPA 1968)). However, if the proposed modification would render the prior-art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *M.P.E.P.* §2143.01 (citing *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984)).

2) Analysis

Claims 34-39, 41-43, 45-50, 52-54, 56-61 and 63-65 were rejected under 35 U.S.C. 103(a) as being unpatentable over *Gardner et al.* (U.S. patent 6,207,995) in view of *Su et al.* (U.S. patent 5,208,472) hereafter referred to as *Su et al.* Applicants respectfully traverse because the Office Action has failed to make a *prima facie* case of obviousness under 35 U.S.C. §103(a) because *Gardner et al.* teaches away the combination *Gardner et al.* and *Su et al.* and further, *Gardner et al.* in view of *Su et al.* fails to teach or suggest all the claim limitations as recited in claims 34-39, 41-43, 45-50, 52-54, 56-61, & 63-65 of the present invention.

Regarding claims 34, 45 and 56, the Examiner asserted,

“Regarding claims 34, 45, & 56, as applied to claims 33, 44, & 55, Gardner discloses that depositing a thin conductive film 50 on the insulating layer 48 (Fig. 3);

patterning and etching the conductive film to form a gate electrode 22 (Fig. 4 & 5).

Gardner fails to teach forming one or more thin insulating layers on one or more sidewalls of the gate electrode.

However, Hossain discloses forming one or more thin insulating layers on one or more sidewalls 19 & 22 of the gate electrode 16 (Fig. 6).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of applicant(s) claimed invention was made to provide Gardner with forming one or more thin insulating layers on one or more sidewalls of the gate electrode as taught by *Su* in order to reduce shorting between the gate and the source/drain region and decreases the damage induced by the stress of the silicide film (Col. 3, lines 6-8).”

As a first matter, claims 34, 45 and 56 depend from independent claims 33, 44 and 55, respectively, which as argued above, Applicants respectfully submit distinguishes over *Gardner et*

al., and applicants respectfully submit that claims 33, 44 and 55 are not obvious over *Gardner et al.* in view of *Su et al.* because *Su et al.* do not remedy the deficiencies of *Gardner et al.* (i.e., *Su et al.* do not provide metal source and drain electrodes that form Schottky contacts with the channel of the device, as recited in the current application). Therefore, claims 34, 45 and 56, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claims 33, 44 and 55. Reconsideration and withdrawal of the rejection are respectfully requested.

Further, Applicants respectfully disagree with the Examiner's assertion that it would have been obvious to one of ordinary skill in the art at the time that the applicant's claimed invention was made to provide *Gardner et al.* with forming one or more thin insulating layers on one or more sidewalls of the gate electrode as taught by *Su et al.* and Applicants respectfully submit that *Gardner et al.* teaches away from the combination of *Gardner et al.* and *Su et al.* As described in *Gardner et al.* (column 8, lines 41 - 45),

"The skilled artisan will appreciate that the process of the present invention enables reliable fabrication of a gate insulating layer and a transistor incorporating the same in a spacerless process that utilizes only a single implant to establish graded source/drain regions."

and further (column 8, lines 49 - 53),

"Spacer functionality is directly integrated into the structure of the gate insulating layer, eliminating the various process steps using conventional processing to fabricate sidewall spacers. Significant savings in material cost and processing throughput may be realized."

Therefore, Applicants respectfully submit that the invention of *Gardner et al.* specifically provides a process that has eliminated the need for a sidewall spacer on the gate as taught by *Su et al.* and thus *Gardner et al.* teaches away from the combination of *Gardner et al.* and *Su et al.* Furthermore, Applicants respectfully submit that the combination of a sidewall spacer as taught by *Su et al.* on the gate electrode of the device of *Gardner et al.* would render the invention of *Gardner et al.* unsatisfactory for its intended purpose because additional masks levels would be required and the manufacturing costs would increase, and thus there is no suggestion or motivation to combine *Gardner et al.* and *Su et al.*

For the reasons provided above, Applicants respectfully submit that the Office Action has failed to make a *prima facie* case of obviousness under 35 U.S.C. §103(a) and therefore claims 34, 45 and 56 appear to be in condition for allowance. Reconsideration and withdrawal of the rejection and an early notification of allowance of the claims are respectfully requested.

Further, regarding claims 35-39, 41-43, 46-50, 52-54, 57-61 and 63-65, as discussed above, Applicants respectfully submit that *Gardner et al.* teaches away from the combination of *Gardner et al.* and *Su et al.* and that there is no suggestion or motivation to combine the sidewall spacer of *Su et al.* with the device of *Gardner et al.* Therefore, Applicants respectfully submit that the Office Action has failed to make a *prima facie* case of obviousness under 35 U.S.C. §103(a) and claims 35-39, 41-43, 46-50, 52-54, 57-61 and 63-65 appear to be in condition for allowance. Reconsideration and withdrawal of the rejection and an early notification of allowance of the claims are respectfully requested.

Regarding claims 35, 46 and 57, the Examiner asserted,

“Regarding claims 35, 46, & 57, as applied to claims 33, 44, & 55, Gardner and Su in combinations disclose that removing metal not reacted during the reacting process (Gardner, col. 8, lines 26-30).”

Claims 35, 46 and 57 depend from independent claims 33, 44 and 55, respectively, which as argued above, Applicants respectfully submit distinguishes over *Gardner et al.*, and as discussed above applicants respectfully submit are not obvious over *Gardner et al.* in view of *Su et al.* Therefore, Applicants respectfully submit that claims 35, 46 and 57, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claims 33, 44 and 55. Reconsideration and withdrawal of the rejection are respectfully requested.

Regarding claims 36, 47 and 58, the Examiner asserted,

“Regarding claims 36, 47, & 58, as applied to claims 33, 44, & 55, Gardner and Su in combinations disclose that the reacting comprising thermal annealing (Gardner, col. 8, lines 13-40).”

Claims 36, 47 and 58 depend from independent claims 33, 44 and 55, respectively, which as argued above, Applicants respectfully submit distinguishes over *Gardner et al.*, and as discussed above applicants respectfully submit are not obvious over *Gardner et al.* in view of *Su et al.* Therefore, Applicants respectfully submit that claims 36, 47 and 58, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claims 33, 44 and 55. Reconsideration and withdrawal of the rejection are respectfully requested.

Regarding claims 33-38, 48-49 and 59-60, the Examiner asserted,

“ Regarding claims 33-38, 48-49, & 59-60, as applied to claims 33, 44, & 55, Gardner and Su in combinations disclose that the source and drain electrode are formed from a member of the group consisting of: platinum silicide, palladium silicide and iridium silicide (Gardner, col. 8, lines 11-19).”

Claims 33-38, 48-49 and 59-60 depend from independent claims 33, 44 and 55, respectively, which as argued above, Applicants respectfully submit distinguishes over *Gardner et al.*, and as discussed above Applicants respectfully submit are not obvious over *Gardner et al.* in view of *Su et al.* Applicants further respectfully submit that the silicide layer of *Gardner et al.* and the source and drain electrodes of *Su et al.* are not equivalent to the metal source and drain electrodes of the present invention, wherein the source and drain electrodes form Schottky-barrier contacts with the channel region. Therefore, *Gardner et al.* in view of *Su et al.* do not describe or suggest the structures arranged as recited in the claims. Therefore, Applicants respectfully submit that claims 33-38, 48-49 and 59-60, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claims 33, 44 and 55. Reconsideration and withdrawal of the rejection are respectfully requested.

Regarding claims 39, 50 and 61, the Examiner asserted,

"Regarding claims 39, 50, & 61, as applied to claims 33, 44, & 55, Gardner and Su in combinations disclose that the insulating layer is formed from a member of the group consisting of metal oxide (Gardner, col. 5, lines 15-25)."

Claims 39, 50 and 61 depend from independent claims 33, 44 and 55, respectively, which as argued above, Applicants respectfully submit distinguishes over *Gardner et al.*, and as discussed above Applicants respectfully submit are not obvious over *Gardner et al.* in view of *Su et al.* Therefore, Applicants respectfully submit that claims 39, 50 and 61, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claims 33, 44 and 55. Reconsideration and withdrawal of the rejection are respectfully requested.

Regarding claims 41, 52 and 63, the Examiner asserted,

"Regarding claims 41, 52, & 63, as applied to claims 33, 44, & 55, Gardner and Su in combinations disclose that the Schottky contact or Schottky-like region is formed at least in areas adjacent to the channel (Gardner, Fig. 2)."

Claims 41, 52 and 63 depend from independent claims 33, 44 and 55, respectively, which as argued above, Applicants respectfully submit distinguishes over *Gardner et al.*, and as discussed above Applicants respectfully submit are not obvious over *Gardner et al.* in view of *Su et al.* Applicants further respectfully submit that the silicide layer of *Gardner et al.* and the source and drain electrodes of *Su et al.* are not equivalent to the metal source and drain electrodes of the present invention, wherein the source and drain electrodes form Schottky-barrier contacts with the channel region. Therefore, *Gardner et al.* in view of *Su et al.* do not form a Schottky contact or Schottky-like region at least in areas adjacent to the channel as recited in the present invention. Therefore, Applicants respectfully submit that claims 41, 52 and 63, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claims 33, 44 and 55. Reconsideration and withdrawal of the rejection are respectfully requested.

Regarding claims 42, 53 and 64, the Examiner asserted,

"Regarding claims 42, 53, & 64, as applied to claims 33, 44, & 55, Gardner and Su in combinations disclose that an entire interface between at least one of the source electrode and drain electrode and the semiconductor substrate forms a Schottky contact 34 or Schottky-like region with the semiconductor substrate (Gardner, Fig. 2)."

Claims 42, 53 and 64 depend from independent claims 33, 44 and 55, respectively, which as argued above, Applicants respectfully submit distinguishes over *Gardner et al.*, and as discussed above Applicants respectfully submit are not obvious over *Gardner et al.* in view of *Su et al.* Applicants further respectfully submit that the silicide layer of *Gardner et al.* and the source and drain electrodes of *Su et al.* are not equivalent to the metal source and drain electrodes of the present invention, wherein the source and drain electrodes form Schottky-barrier contacts with the channel region. Therefore, *Gardner et al.* in view of *Su et al.* do not form a Schottky contact or Schottky-like region with the entire interface of the semiconductor substrate as recited in the present invention. Therefore, Applicants respectfully submit that claims 42, 53 and 64, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claims 33, 44 and 55. Reconsideration and withdrawal of the rejection are respectfully requested.

Regarding claims 43, 54 and 65, the Examiner asserted,

"Regarding claims 43, 54, & 65, as applied to claims 33, 44, & 55, Gardner and Su in combinations disclose that dopants are introduced into the channel (Gardner, col. 1, lines 14-15, note: substrate is lightly doped)."

Claims 43, 54 and 65 depend from independent claims 33, 44 and 55, respectively, which as argued above, Applicants respectfully submit distinguishes over *Gardner et al.*, and as discussed above Applicants respectfully submit are not obvious over *Gardner et al.* in view of *Su et al.* Therefore, Applicants respectfully submit that claims 43, 54 and 65, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claims 33, 44 and 55. Reconsideration and withdrawal of the rejection are respectfully requested.

Claims 5, 11, 13, 19 and 28 were rejected under 35 U.S.C. 103(a) as being unpatentable over *Gardner et al.* (U.S. patent 6,207,995) in view of *Buchanan et al.* (U.S. patent 6,245,616) hereafter referred to as *Buchanan et al.* Applicants respectfully traverse because the Office Action has failed to make a *prima facie* case of obviousness under 35 U.S.C. §103(a) because *Gardner et al.* in view of *Buchanan et al.* fails to teach or suggest all the claim limitations as recited in claims 5, 11, 13, 19 and 28 of the present invention.

Regarding claims 5, 11, 19 and 28, the Examiner asserted,

“Regarding claim 5, 11, 19, 28, as applied to claims 5, 2 or 3, 15, & 24, Gardner discloses the insulating layer 20.

Gardner fails to teach the insulating layer is formed from an oxy-nitride stack. However, *Buchanan* suggests that the insulating layer is formed from an oxynitride stack 20 (Fig. 1).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of applicant(s) claimed invention was made to provide Gardner with the insulating layer is formed from an oxy-nitride stack as taught by *Buchanan* in order to reduce channel hot electron damage (col. 1, lines 14-15).”

Claims 5 and 11 depend from independent claim 1 or an intermediary claim, that itself depends from claim 1, claim 19 depends from independent claim 15 and claim 28 depends from independent claim 24, each of which as argued above, Applicants respectfully submit distinguishes over *Gardner et al.*, and Applicants respectfully submit that claims 1, 15 and 24 are not obvious over *Gardner et al.* in view of *Buchanan et al.* because *Buchanan et al.* do not remedy the deficiencies of *Gardner et al.* (i.e., *Buchanan et al.* do not provide metal source and drain electrodes that form Schottky contacts with the channel of the device, as recited in the current invention). Therefore, claims 5, 11, 19 and 28, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claims 1, 15 and 24. Reconsideration and withdrawal of the rejection are respectfully requested.

Regarding claim 13, the Examiner asserted,

“Regarding claim 13, as applied to claim 11, Gardner and Buchanan in combinations disclose that the Schottky contact or Schottky-like region is formed at least in areas adjacent to the channel (Gardner, Fig. 2).”

Claim 13 depends from claim 11, which depends from independent claim 1, which as argued above, Applicants respectfully submit distinguishes over *Gardner et al.*, and as discussed above Applicants respectfully submit is not obvious over *Gardner et al.* in view of *Buchanan et al.* Applicants further respectfully submit that the silicide layer of *Gardner et al.* and the source and drain regions of *Buchanan et al.* are not equivalent to the metal source and drain electrodes of the present invention, wherein the source and drain electrodes form Schottky-barrier contacts with the channel region. Therefore, *Gardner et al.* in view of *Buchanan et al.* do not form a Schottky contact or Schottky-like region at least in areas adjacent to the channel as recited in the present invention. Therefore, Applicants respectfully submit that claim 13, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claim 1. Reconsideration and withdrawal of the rejection are respectfully requested.

Claims 40, 51 and 62 were rejected under 35 U.S.C. 103(a) as being unpatentable over *Gardner et al.* in view of *Su et al.* and further in view of *Buchanan et al.* Applicants respectfully traverse because the Office Action has failed to make a *prima facie* case of obviousness under 35 U.S.C. §103(a) because *Gardner et al.* teaches away from the combination of *Gardner et al.* and *Su et al.* and further because *Gardner et al.* in view of *Su et al.* and further in view of *Buchanan et al.* fails to teach or suggest all the claim limitations as recited in claims 40, 51 and 62 of the present invention.

Regarding claims 40, 51 and 62, the Examiner asserted,

“Regarding claim 40, 51, & 62, as applied to claims 33, 44, & 55, Gardner and Su in combinations disclose the insulating layer 20.

Gardner and Su fail to teach the insulating layer is formed from an oxy-nitride stack.

However, Buchanan suggests that the insulating layer is formed from an oxynitride stack 20 (Fig. 1).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of applicant(s) claimed invention was made to provide Gardner and Su with the insulating layer is formed from an oxy-nitride stack as taught by Buchanan in order to reduce channel hot electron damage (col. 1, lines 14-15)."

As a first matter, claims 40, 51 and 62 depend from independent claims 33, 44 and 55, respectively, which as argued above, Applicants respectfully submit distinguishes over *Gardner et al.*, and Applicants respectfully submit that claims 40, 51 and 62 are not obvious over *Gardner et al.* in view of *Su et al.* and further in view of *Buchanan et al.* because *Su et al.* and *Buchanan et al.* do not remedy the deficiencies of *Gardner et al.* (i.e., *Su et al.* and *Buchanan et al.* do not provide metal source and drain electrodes that form Schottky contacts with the channel of the device, as recited in the current invention). Therefore, claims 40, 51 and 62, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claims 33, 44 and 55. Reconsideration and withdrawal of the rejection are respectfully requested. Therefore, Applicants respectfully submit that claims 40, 51 and 62, when considered as a whole, appear to be in condition for allowance for at least the same reasons as claims 33, 44 and 55. Reconsideration and withdrawal of the rejection are respectfully requested.

Further, as discussed above, Applicants respectfully submit that *Gardner et al.* teaches away from the combination of *Gardner et al.* and *Su et al.* and that there is no suggestion or motivation to combine the sidewall space of *Su et al.* with the device of *Gardner et al.* and the addition of *Buchanan et al.* is not able to remedy this deficiency. Therefore, Applicants respectfully submit that the Office Action has failed to make a *prima facie* case of obviousness under 35 U.S.C. §103(a) and claims 40, 51 and 62 appear to be in condition for allowance. Reconsideration and withdrawal of the rejection and an early notification of allowance of the claims are respectfully requested.

AMENDMENT AND RESPONSE

Serial Number: 10/796,514

Filing Date: March 9, 2004

Title: TRANSISTOR HAVING HIGH DIELECTRIC CONSTANT GATE INSULATING LAYER AND SOURCE AND DRAIN FORMING SCHOTTKY CONTACT WITH SUBSTRATE

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Attorney Docket: 6932.14467.05

CONCLUSION

Applicants respectfully submit that claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's agent David J. King (952-435-0208) to facilitate prosecution of this application.

If required and not otherwise provided, please consider this a Petition for Extension of Time for the necessary number of months for filing a reply in the above-identified application. Please charge any required fee or credit overpayment to Deposit Account No. 502931.

Respectfully submitted, John P. Snyder

By their representative, David J King
14565 Grand Avenue
Burnsville, MN 55306

TELEPHONE: 952-435-0208

Date: November 24, 2008

By: /David J. King/
David J. King Reg. No. 53,132

CERTIFICATE UNDER 37 CFR 1.8(a)(1)(i)(C):

I hereby certify that this document is being electronically filed via the U.S. Patent Office's EFS-Web filing system on this **24th day of November, 2008, Central Time**, addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Name: David J. King, Reg. No. 53,132

Signed: /David J. King/